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Process for the continuous molding of thermosetting compositions. [stamp]

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The molding of thermosetting materials is generally carried out discontinuously, given that, on the one hand, a controlled molding of the sample is necessary and, on the other hand, gradual heating of the material to be polymerized is required. But this discontinuous molding constitutes a very expensive operation because it requires the use of many machines. If industrial productions are desired, it often involves the use of very large presses, and, finally, it always requires the use of fairly heavy manpower.

The subject of this invention relates to a molding line for compositions containing thermosetting materials which makes it possible to continuously prepare various objects and/or profiles. The equipment as claimed in the invention is characterized by the fact that it comprises in succession a pre-molding area, a drive for putting in and positioning the pre-molded form, and an oven which comprises, in its first part, the actual molding machine, which is made up of at least two pairs of wheels around which are wound sets of metal parts of an appropriate shape and linked to each other; in the course of their rotation, these sets of metal parts squeeze the molding composition in order to give it the desired final shapes.

The continuous molding process and equipment are schematized in Figures 1 through 7.

Figure 1 shows a schematic drawing of the overall molding system.

Figure 2 shows a cross-sectional view of an example of a pre-form obtained at the end of the pre-molding operation.

Figure 3 shows the drive that can be used to drive and position the pre-formed profiles shown in cross section in Figure 2.

Figure 4 shows a sectional view of the actual molding machine; this machine can be used to prepare profiles of a simple shape.

Figure 5 shows a sectional view of the actual molding machine used to prepare corrugated sheets.

Figure 6 shows a sectional view of the actual molding machine used to prepare profiles of complex shapes.

Figure 7 shows a cross-section of an embodiment of the continuous molding machine as claimed in the invention to produce profiles of complex shapes.

Figure 1 shows a schematic drawing of the overall molding system; this system consists of a series of conveyor belts on which occur one by one:

In A, preparation of the molding compound;
In B, pre-forming of the profile;
In C, the driving of this profile;
In D, the actual molding of the profile;
In E, stoving of the profile;
In F, cutting of the profile.

Part A of Figure 1, showing the preparation of the molding compound, comprises a conveyor belt 1 on which a sheet of cellophane film 2 is unrolled; the liquid plastic material 3 and then a glass mat 4 are deposited on this sheet; the glass mat is gradually incorporated into the plastic material using scrapers 5; then in 6, a second layer of compound and in 7, a new cellophane sheet are deposited.

The sandwich composite thus obtained is then pre-formed in part B of the molding line. This pre-forming is carried out by sliding the sandwich composite over a cradle of which the shape duplicates the general shape of the profile that is desired. From position to position, mandrels or wheels mounted on axles perpendicular to the movement of the material force the material to

gradually take the shape of the cradle.

At the end of the pre-forming, the sandwich composite enters into a driving machine C, of which the purpose is to exert traction on the pre-form obtained in order to pull the material out of the pre-form and put it into the actual molding machine in an exactly positioned manner:

The lower part of the molding machine D consists of a series of linked metal cradles 8 that rotate around two drive wheels 9 and 10. The drive wheel 9 is itself connected to a suitably chosen motor. In 11, the various cradles form a continuous surface over which the lower face of the pre-formed sandwich moves. The upper part of the molding machine is also made up of metal parts rotating around two drive wheels 12 and 13. If a profile with a simple shape is desired, these rotating metal parts merely have the shape of the upper part of a mold that fits into the female part of the mold made up of the lower metal cradles 11. If, in contrast, the profile to be produced requires some folding operations, the upper rotating metal parts are made up of mandrels that engage the sandwich composite at various points of the molding. This molding machine D is enclosed in an oven within which the temperature is high enough to induce the polymerization of the elements contained in the compound material used.

The material leaving the molding machine then continues its movement into an oven E in which the polymerization is completed. Upon leaving this oven, the profile is cooled and appropriately cut by a cutter F.

The dimensions of the various parts of this continuous molding line obviously must be adapted to the pieces to be prepared and to the material used. When the previously described molding compound is used, it has been determined that the dimensions of the pre-form and of the molding machine must be such that the retention times of the material in the pre-form and in the machine must be between 2 and 5 minutes.

Figure 2 shows the cross-sectional view of the material as it leaves the pre-form for the preparation of profiles; the manufacture of profiles that can be used for door jambs has been taken as an example. The profile obtained consists of two outer layers of cellophane between which the moldable composition as claimed in the invention is contained. A later cutting made lengthwise in the profile will make it possible to cut the profile into several elementary profiles that will be appropriately molded in the continuous molding machine. Such a relatively complex profile shape, made from a moldable material that is not yet polymerized, demonstrates the importance that must be placed on the composition and to the properties of this moldable material. In addition, it must be viscous enough so that no significant flow or any segregation of the various elements of which it is composed appears in it.

This pre-formed material is put into the drive C, of which a front view is shown in Figure 3. The drive is essentially made up of a certain number of wheels that can rotate around suitably chosen axles so as to squeeze the profile on its various flat faces without further changing the shape of the profile. Owing to a manually controlled drive system, for example, the rubbing of the wheels on the cellophane surfaces of the profile pulls the profile out of the pre-form and puts it into the continuous molding machine. Thus, this drive has two essential functions; on the one hand, it allows the profile to move easily in a place where its malleability is still very great and, on the other hand, allows this profile to be put into the molding machine, positioning it very accurately.

Figure 4 shows a sectional-view of the actual molding machine. The machine includes the various aforementioned elements, i.e., the wheels 9, 10, 12, and 13 around which plates of which the shape is adapted to the profile that is desired rotate in the manner of the caterpillar tread of some industrial vehicles. As has been noted, the wheels 9 and (possibly) 12 are the only drive wheels that allow in this way, given the direction of movement of the profile indicated by the arrow F, a take-up of the play between the various plates in the actual molding area.

In Figure 5, a cross-section of this same machine being used to prepare corrugated sheets is shown.

The continuous molding machine as claimed in the invention may also be modified to prepare profiles that have much more complex shapes and that require, for example, the positioning and controlled outflow of several mold shapes. Such a device is shown in Figure 6. The lower part of the mold is, as before, made up of linked female elements that rotate around two wheels 9 and 10 (the wheel 9 being a drive wheel). The upper part of the mold, made up of linked elements, rotates around two systems of wheels 12, 12′ and 13, 13′. But in addition, there remain in 14-15 and 16-17 other pairs of wheels that also drive, in the manner of caterpillar treads, linked elements that are inserted in the upper part of the mold so as to imprint a certain shape onto the material. In this way, during the continuous molding, the material can be shaped accurately and in a complex manner.

Figure 7 shows an example of the production of a specially shaped profile owing to the form of embodiment of the invention. The pre-formed material that rests on the lower part of the mold 19 is seen in 18 in this figure. Then the parts 20, 21, and 22 of the upper part of the mold were put into place one after another. At this stage, the material may, for example, be cut using the cutters 23-23′ and folded down following the arrows 24. When the material has reached its final shape, the central part 22 slips out, the parts 22 come together and can in that way slip out, and the central part 20 is removed. Thus, a profile of a complex shape has been produced in a continuous manner and it will continue to be cured in an oven at an appropriate temperature.

SUMMARY

I. This invention relates to a process for continuously molding a compound containing a thermosetting polymer characterized by the fact that it comprises, in turn, an area for preparing the material to be molded, which consists of a multilayered thermosetting viscous material sandwiched between two thin sheets of thermoplastic material, a pre-forming area ending in a drive machine, a continuous molding machine consisting of at least two pairs of wheels around which are wound two sets of linked metal forms of which the coming together constitutes the mold, and a curing oven to complete the polymerization of the thermosetting constituent of the compound used.

II. This invention also relates to the equipment for implementing the molding process as claimed in I, characterized by the following points considered separately or in combination:

1. The pre-forming of the material is carried out in a pre-form of which the length is such that the retention time of the material in this pre-form is on the order of 3 to 8 minutes and which consists of a cradle of which the flat shape in the upstream part of the pre-form gradually changes so as to assume the shape of the lower part of the mold, and of mandrels or moveable wheels around fixed axles that from position to position force the material to assume the shape of the pre-form cradle.

2. The drive machine consists of wheels that move around fixed axles and that are arranged so that the interval between the upper wheel set and the lower wheel set duplicates the shape of the material that leaves the pre-form.

3. The continuous molding machine consists of a pair of lower wheels located in the same plane and arranged in a continuation from one to the other in the direction of movement of the material, these wheels driving, by means of the upstream drive wheel, an uninterrupted series of linked metal forms that constitute the lower part of the mold, and of at least one pair of upper wheels also located in the same plane and arranged in a continuation from one to the other in the direction of movement of the material, these pairs of wheels each driving, by means of their upstream drive wheel, an uninterrupted series of linked metal forms that constitute the upper part(s) of the mold.

4. The molding machine is enclosed in an oven in which the temperature is high enough to induce the polymerization of the thermosetting compound contained in the starting material.

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